

measuring distance to ground such as an ultrasonic transducer can be added to provide more precise altitude readings during the final stages of landing. Position sensors for the engine and flight controls can also be added. A video camera can also be mounted inside the cockpit area and with the aid of digital video compression, the most recent images of a flight can be recorded in memory. For the wireless data transceiver, Bluetooth technology, the emerging standard for short range communications, can also be used. Instead of radio frequency, infrared techniques such as the one described by the IrDA standard can also serve as the wireless medium. As far as the host computer is concerned, a hand-held personal digital assistant, such as a Palm Pilot with the appropriate application software, can also be used.

Accordingly, the scope of the invention should be determined not by the embodiment illustrated, but by the appended claims and their legal equivalents.

### **Abstract**

A flight data recorder designed for small aircraft captures various onboard flight data in real-time and stores it in non-volatile memory. Recorded data includes aircraft's instantaneous position, altitude, attitude, engine RPM, G forces, flap position, cockpit voice and others. These data are obtained from various sensors which are integrated into the recorder. At the end of a flight the recorded data is downloaded into a computer using a wireless communications data transceiver also integrated into the recorder. It is an inexpensive system that does not require interfacing to any of the aircraft's instruments. It does not require removal or attaching any equipment to be able to download data. In addition to accident investigation, applications include training, preventive maintenance and asset monitoring.

### **Claims**

What is claimed is:

1. A flight data recording system comprising:

a single apparatus installed on board an aircraft further comprising:

a plurality of sensors for measuring and detecting the condition of the aircraft and its surroundings;

a plurality of sensors and devices for monitoring the operation of the aircraft's power plant;

a device for monitoring the activity of the crew;

a global positioning satellite receiver that generates the position information of the aircraft based on signals received from navigation satellites;

a central processing unit that acquires, processes and stores the data from the sensors, devices and global positioning satellite receiver;

a plurality of non-volatile memory modules for recording flight data obtained from said sensors, devices and global positioning satellite receiver;

a device for retrieving said flight data from a remote location using a wireless means of communications;

and a data retrieving apparatus located on the ground and used for retrieving said flight data from said non-volatile memory.

2. The system of claim 1 wherein majority of said sensors and devices and said central processing unit, global positioning satellite receiver, non-volatile memory and wireless retrieving device are all integrated into said single apparatus installed on board the aircraft.
3. The system of claim 1 wherein said sensors and devices are independent of the aircraft's instruments, thereby simplifying the effort needed in installing the flight data recorder on board the aircraft.
4. The system of claim 1, further comprising an enclosure which is water resistant, impact resistant and fireproof and housing all the elements of said single apparatus installed on board the aircraft.

5. The system of claim 1, further including an apparatus comprising a separate non-volatile memory that stores the same said flight data.
6. The apparatus of claim 5 wherein said memory is enclosed in its own water resistant, impact resistant and fireproof encapsulation, such that when the other elements of the flight data recorder are damaged, there is still a high probability that the recorded data can be retrieved from said apparatus.
7. The apparatus of claim 5, wherein said apparatus is integrated in said enclosure of claim 4.
8. The system of claim 1 wherein said ground based data retrieving apparatus includes a general-purpose computer interfaced to a wireless communications device.
9. The apparatus of claim 8 wherein said computer can either be stationary or portable.
10. The system of claim 1 wherein said wireless means of communications can operate both above ground and underwater.
11. A method of recording flight data in an aircraft comprising:

collecting flight data from sensors which monitor the condition of the aircraft and its surroundings;

collecting data from sensors which monitor the operation of the aircraft's power plant;

acquiring data from devices which monitor the activity of the crew;

acquiring aircraft position information from a global position satellite receiver;

processing data acquired from said sensors, devices and global positioning receiver;

storing said data in a plurality of non-volatile memory modules;

transferring said data to a ground based data retrieving apparatus using a wireless means when the aircraft is on the ground;

converting, displaying and storing said data on the ground based data retrieving apparatus.

12. The method of claim 11, wherein said step of storing further includes the step of recording relative position data instead of absolute position data, thereby reducing the memory space needed for recording said data.
13. The method of claim 11 wherein said step of storing further includes the step of varying, at the option of the user, the amount of flight data recorded per unit time according to flight conditions.
14. The method of claim 13 wherein said flight data are recorded more frequently during the more critical stages of a flight, such as landing and take-off, than during taxiing and cruising.
15. The method of claim 11 wherein said step of transferring data further includes the step of detecting errors during the data transfer and automatically re-trying the data transfer when errors are encountered.
16. The method of claim 11 wherein said step of converting data includes converting relative position data to absolute position data and converting the raw sensor data into meaningful forms.
17. The method of claim 11 wherein said step of displaying data further includes graphically displaying plots of the aircraft flight paths from different views and the sensor data at every point in the flight path.